THURSDAY, NOVEMBER 9, 1905.

STRENGTH OF MATERIALS.

Mechanics of Materials. By Mansfield Merriman. Tenth edition, re-written and enlarged. Pp. xi+507. (New York: Wiley and Sons; London: Chapman and Hall, Ltd., 1905.) Price 21*s.* net.

THE great development of engineering schools in the United States has led to the production of a considerable number of technical text-books primarily intended for students. It may at once be stated that, taken as a whole, these books are increasingly scholarly and sound; but they are largely compiled from similar European text-books, and often disclose a want of any serious independent investigation of the subject dealt with.

The present book is in some respects an excellent treatise, and as it has reached a tenth edition it must have been found useful. It deals with the elastic and, to a limited extent, with the plastic properties of materials of construction and the application of the laws of strength of materials to the simpler machine parts and structures. The treatment is essentially theoretical, and the book must be judged by the way in which it presents theory to students. The first point which strikes a reader is the great looseness of terminology. In the first two or three pages tension, tensile force, pull and axial force are all used as equivalent, which may not be wrong, but is confusing. Also a compression is a shortening, a sliding (in shear) is a detrusion, and the word strain does not appear in the volume, which is unusual. Young's modulus is termed throughout *the* modulus of elasticity; the condition that lateral contraction is unhindered is not explained. The coefficient of rigidity is referred to (p. 38) as the "modulus of elasticity for shear," but the relation of E and G is not discussed until p. 465. The volumetric modulus is described on p. 467, but these are the only elastic coefficients mentioned.

The author has an aggravating way of describing a thing at first very crudely and inaccurately, but without any reservations, giving a revised statement much later on and a further revision later still, and this in the case of quite simple matters. Take, for instance, the treatment of shear. On p. 38 the author takes as the typical example of shear a force P acting at the end of a T-shaped short beam. This is, of course, a case of shear and bending, and the rectangular elevation of the beam would not become a rhombus as the author states. The shear on horizontal planes is not referred to, and the unit stress is given as P/a without any caution that it is not uniformly distributed; and it is from this complex case that he deduces, as if it were a simple shear, the coefficient of rigidity. All this is inaccurate and confusing to students. It is not until p. 264 that it is explained that shear on one pair of planes is accompanied by an equal shear on a pair of planes at right angles, and on p. 465 the author goes back to representing shear as a single couple on a pair of parallel planes. In both Figs. 15 and 181 the deformation is so drawn that a student would infer a change of volume in shear, and nowhere, so far as can be found, is the constancy of volume in shear referred to. On p. 14 the end of a beam strained by a couple is used as an illustration of shear. The unit shearing stress is given as P/a, which is only the mean stress, and it is added that the bar will shear off when P/a is "equal to the ultimate shearing strength of the material," which is not the case. Can a more misleading statement for a student be imagined than (p. 14) "tensile and compressive stresses usually act parallel to the axis of a bar, but shearing stresses at right angles to it"? or this statement, p. 363, "it is best to consider shear as a signless quantity"? All these matters are elementary, and they are not so much wrong as slovenly and confusing—and similar faults occur constantly.

When the elastic limit is exceeded, the strains increase faster than the stresses. "Therefore the elastic properties of a bar are injured when it is stressed beyond the elastic limit." It would not be exact, but it would be more accurate, to say that the elastic properties are improved by straining beyond the elastic limit. "Accordingly it is a fundamental rule that the unit stresses should not exceed the elastic limit." The large deformation in ordinary materials beyond the elastic limit is the primary reason for limiting stresses to the elastic strength. It would be undesirable for a bridge to deflect several feet. The elastic limit is always assumed by the author to be a definitely fixed stress, and its variation under variation of loading is never referred to.

> "The stresses are usually computed for dead and live loads separately regarding each as a static load. The live load, however, really produces greater stresses than the computed ones."

The live load undoubtedly may cause rupture when an equal dead load would not, but the author's statement is extremely doubtful, and the question is one of the most fundamental in applying the rules of strength of materials, and should on no account be slurred over in a text-book. The account of Wöhler's fatigue experiments (p. 352) is very brief and imperfect. American bridge builders have never fully accepted Wöhler's results, and have been disposed to explain the smaller working stress in members subject to great variation of stress as justified by the effect of impact. Practically it does not matter much whether the reduction of the working stress is termed an "allowance for impact" or "an allowance for fatigue," but it is a fundamental point, and the author's treatment of it on p. 358 will not much help a student. The author's theory that a live load produces more stress "because it is applied quickly," and the statement that the dynamic stress T can be expressed in terms of the static stress S by the relation $T=\phi(t)S$, where $\phi(t)$ is a function of the time of application, will require much more investigation before it is accepted. The effect of variation of stress in inducing fatigue, the effect of impact or of loads which have kinetic energy before deformation begins, and of loads which are unbalanced so that they acquire kinetic energy during deformation, require

© 1905 Nature Publishing Group

careful discrimination. The effects should not be lumped together as due to suddenness.

A good deal of space is devoted to what the author terms "true stresses." He takes the well known strain equations $E\epsilon_1 = S_1 - \lambda S_2 - \lambda S_3$, &c., and, because $E\epsilon_1$ is of the same form as stress in terms of extension, he calls $E\epsilon_1$ the "true stress" due to the "apparent stresses" S_1, S_2, S_3. This is to use the term "stress" in a totally new sense. The real stresses which balance the external forces are only "apparent stresses"; an imaginary stress which is greater is the "true stress." It is impossible here to follow the author to the curious results he arrives at, which involve a revision of all the ordinary formulas of strength. It is not difficult to see from what point he has drifted. He throughout implicitly assumes that the condition of security in a structure depends on the maximum stress. He nowhere discusses the other views which have been taken. Now one of these is that security depends, not on maximum stress, but on maximum strain. What the author does with his equations is to make security depend on the maximum strains ϵ_1, &c.; but this does not justify him in calling $E\epsilon_1$ a true stress.

A HANDBOOK OF FLOWER BIOLOGY.

Handbuch der Blutenbiologie. Vol. iii. Part ii. By Ernst Loew, assisted by Otto Appel, completing the work commenced by Paul Knuth. Pp. v+601. (Leipzig: Wilhelm Engelmann, 1905.) Price 18*s.* net, in paper cover.

THE work which the late Prof. Knuth projected and commenced—a "Handbook of Flower-Biology," to replace Hermann Müller's "Fertilisation of Flowers"—is now complete. It runs as follows:—vol. i., an advanced text-book of flower biology; vol. ii., an account of observations made in Europe (two parts); vol. iii., an account of observations made outside Europe (also two parts).

Ernst Loew, who, after Knuth's death, undertook the completion of the work, appends to the last part a review of the collected extra-European observations.

There can be no doubt of the preeminent fitness of Dr. Loew for his task; but the result on close criticism is found just a little disappointing on account of omissions, *e.g.* Willis's observations on Phacelia, Monarda, and Ixora, and Keeble's on Loranthus, incorrect citations—at the rate of one per page in the literature-list—an imperfect index, far too many printer's errors, and illustrations not always, I believe, drawn from the living flower.

Dr. Percy Groom (NATURE, vol. lxxi. p. 26) remarked on omissions and printer's errors in reviewing the preceding part of this work.

Of the body of the work, it is to be said that, besides abstracting all pertinent publications that have fallen into Dr. Loew's hands, it gives to the world a considerable number of original observations made by Knuth in Java, Japan, and California, and a few of Loew's made in the Berlin Botanic Garden, and that the names of North American insects have been subject to a revision by Prof. Robertson, of Carlinville, Illinois.

Of the review, it is to be explained that it centres on a discussion of the fertilising agents in countries outside Europe. I greatly appreciate the vast amount of labour which Dr. Loew has put into it. He could hardly have made greater use of the fragmentary material to hand. But the account of fertilisation in the tropics wants atmosphere; it is such as a man would write who had no particular experience of their vegetation. Twelve pages of the review are given to this account: first, Dr. Loew borrows from Prof. Warming a description of the vegetation of Lagoa Santa, in Brazil; then he goes on very successfully to discuss the part which birds play in fertilising flowers. In the place of the description of Lagoa Santa, one had hoped to find a more general description of tropical seasons. Nearly twelve pages are given to an account of fertilisation in New Zealand and the Antarctic islands—chiefly to a comparison of Arctic and Antarctic flowers, wherein Loew sees less agreement than does Delpino. Four and a half pages are given to South Africa with Madagascar—an ill-assorted union, three to the cactus region of N. America, six to the Arctic region including Spitzbergen, and twenty-six to the forest belt of N. America. I have here set down the number of pages devoted to each region because they rightly indicate the proportion in which the regions have been studied.

In dealing with the forest belt of N. America, Loew depends, of course, on Robertson's excellent work; there alone he really finds facts enough to enable him to work in the statistical methods which he has used so extensively in his writings regarding European flowers.

A time will come when the botanists of North America ask for a handbook of North American flower biology. Loew's work shows how far from readiness is material for it, and how very much further from readiness is material for a handbook of flower biology for any other part of the world. Until we get such handbooks, Loew's volume of Knuth's work will remain very useful on account of its suggestions, its references, its information, and especially as a companion in travel. I. H. B.

A FRENCH BOOK ON SPORT AND TRAPPING.

Chasse, Élevage et Piégeage. By A. de Lesse. Encyclopédie Agricole. Pp. xii+532; illustrated. (Paris: J. B. Baillière and Son, 1905.) Price 5 francs.

THE volume before us is one of a series dealing not only with subjects pertaining to agriculture in its proper and more restricted sense, but likewise with practically everything connected with country life which has any bearing at all on that pursuit. In the present instance, the subject of the trapping and snaring (*piégeage*) of animals, which, in the case of noxious species is, of course, a matter of considerable importance to the agriculturist, serves to establish a connection between sport (especially in the French sense of that term) on the one hand and agriculture on the other, and thus justifies the inclusion of the volume in the series. In connection

© 1905 Nature Publishing Group